SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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THE "PALMERSTON FURNACE"---D. MUSHET'S PATENT.

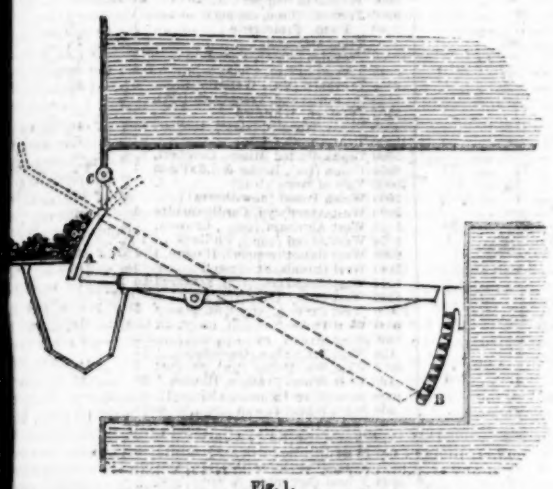


Fig. 1.

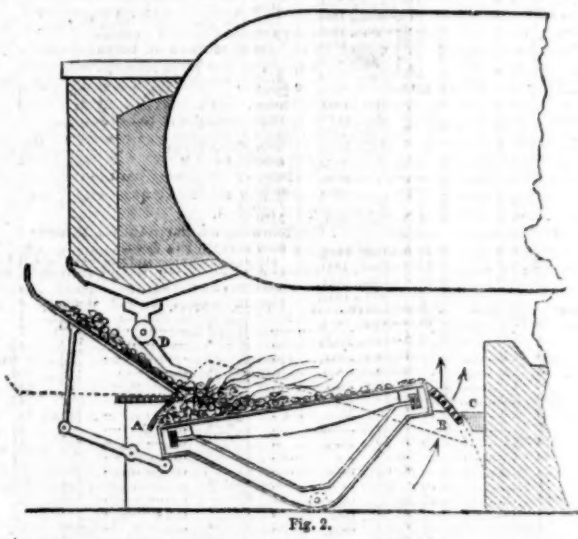


Fig. 2.

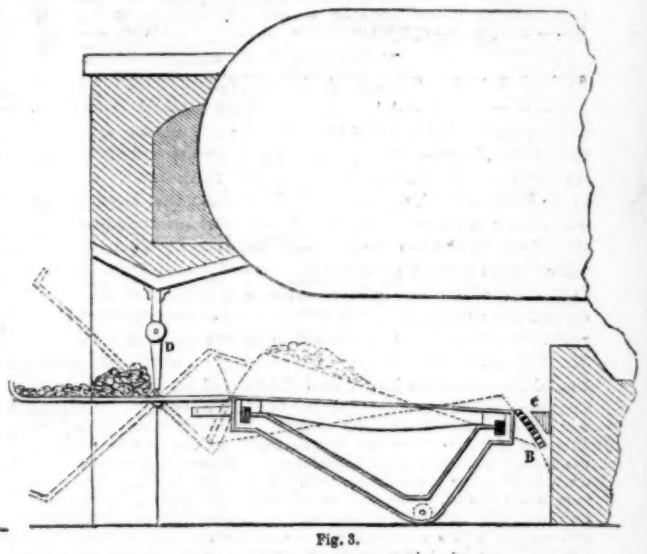


Fig. 3.

Sir,—I now forward you, as promised, some forms of my patent grate, which, from the ease, clearness, and decision of action, its mobility and disposition to abate the smoke nuisance, I have ventured to designate the "Palmerston Furnace"—a comprehensive title, conspicuously referring at once to cause, effect, and occasion.

The general principle of the invention is to apply various movements, not to the individual bars as hitherto, but to a frame which supports them. The movement carries all the bars with it, and obtains changes of position, which facilitate the entrance of the fuel, the stoking, and simultaneously provide such extra supply of air as is required for perfect combustion. The motion I usually prefer is derived from balancing the grate frame on a more or less central pivot. This pivot may be on a level with the bars, or it may be placed at any convenient depth beneath that level, to obtain a series of flatter curves; and these differences, united with the equal or unequal position of the pivot, forward or backward, command a variety of action to suit every requirement.

Fig. 1 represents a simple arrangement particularly calculated for marine boilers, or any others where rapid and constant firing is the desideratum. The pivot is here placed at the level of the grate, and unequally at a distance of one-fourth from the front end of the frame. This division enables the bars to be brought into a considerably inclined plane with a proportionally small elevation of their front ends, and, therefore, with a corresponding small height to lift the coals. The usual dead plate for keeping the fire from the front of the furnace is attached to the grate framing, and moves against the plate, A, which is fixed across the front of the furnace, and curved to the circle, described by the extremity of the dead plate. At the back of the ash-pit is fixed a plate, B, grated, or perforated, to admit air in small streams during the depression of the back end of the grate for feeding, and curved to the larger circle, described by the long radius of the framing. The grate is shown in its permanent position, with the feeding hopper filled with coals. This is simply an iron plate guarded on three sides, but with the front end open, and sliding against the outside of the curved plate, A. The movement of the grate is obtained by a lever, omitted in the delineation as an accidental, not illustrative of the principle. When the back end of the grate is suffered to fall more or less rapidly, according to requirements, the hopper, sliding on curved guide rods, is lifted by the connections proceeding from the front end of the grate framing. The coals as they rise fall gradually through the swing door, C; while more and more air for the ignition of the increasing evolution of gas enters through the pierced plate, B, as the ascent of the grate continues to uncover its perforations. When the plate and the hopper reach the position shown by the dotted lines, the whole of the coals will have been discharged into the fire. Falling on an inclined plane, they are distributed in a most advantageous manner—the small remaining towards the front, and the larger pieces rolling to the back, ensure an open fire near the bridge. The natural tendency of the fuel to accumulate a thick fire near the bridge is a smoke producer, which experienced stokers carefully avoid. The charge being delivered, the grate is restored to its permanent position. The gases having been emitted during the gradual feeding by small jets of air, admitted at the hottest part of the furnace, instead of the cooling mass in front, which enters by the ordinary fire-door at that period, the chill and diminution of draught which ensues on the production of smoke is avoided, and smokeless combustion will continue. A minute and beneficial film of air finds its way through the space left for play and expansion at the back circle; and if the quantity or the quality of the charge demands it, the front end of the bars may be depressed ¼ in., or upwards, below the edge of the fixed plate, A. The occasional depression of this part of the grate (the edge of the plate, A, can be vaulted, to avoid a too continuous gap) likewise furnishes an opening for dressing the fire; and the sheet of air then driving it will destroy the smoke of the most bituminous coal, however moved. A narrow tip or shoot may be fixed inside the top of the plate, A, to carry the last fall of coal beyond the dead plate.

Fig. 2 (represented in the act of feeding) is an arrangement for furnaces, which permit of a more slow and economical process of combustion. It can be readily fitted where there is a dead plate already built into the walls, and where a projection of brickwork for flues overhanging the door may render the first figure not conveniently applicable. In this modification, the fuel is fed upon the front end of the grate by depressing it, and the air admitted at the back end when rising towards the bridge. A is a plate, either plain or perforated, attached to the dead plate, and curved to the circle, described by the front end of the grate frame. B is a similarly curved plate, attached to the back end of the frame, and perforated. C is a clinker plate, or iron block, set in the brickwork of the bridge. When the front end of the grate is gradually depressed by the proper lever, the hopper, or feed plate, lying horizontally on the dead plate in the position of the dotted lines, is carried up, and by degrees discharges the feed of coal through the swing door, D. Simultaneously, the perforated plate, B, rises above the level of the clinker plate, or block, and admits radiating streams of air, increasing in quantity with the increase of fuel. This is a very powerful "smoke-consumer." The fire being properly prepared for feeding by pushing plenty of the incandescent coke towards the back of the grate, all the gas evolved by each succeeding increment of coal passing over the clear fire, before reaching the jets of air is fully prepared for ignition. The air and the incipient smoke come into contact at the hottest point of the furnace. Immediately the feeding is completed, the grate must be restored to its level, to prevent injury to the back ends of the bars. During feeding, while the fuel is yet cold, and the gases evolving from it very cool, no ill effects will arise from their passage over the elevated end of the bars; but as there is no chill produced in the furnace and in the flues by the evolution of smoke, all the gases being converted to flame on passing the air-plate, the front of the furnace will quickly recover its heat. The back end of the grate must, therefore, be brought to its level after feeding, with the same dispatch and precision as attends the shutting of the ordinary fire-door. For bituminous coal, the hopper plate can be so adjusted that, when it is in its horizontal position, a sheet of air will pass beneath it over the dead plate directly against the fuel. Air which enters a furnace only through the fuel on the bars, becomes so charged with carbonic acid as to be unfit for the ignition of the gases—hence the powerful effects of air admitted through a purer channel. This opening may, likewise, be made serviceable for dressing and levelling the fire, instead of moving the swing door over the hopper. The angular form of this door assists the coal in entering when the hopper rises.

In this figure the axis of oscillation is placed in the ash-pit, considerably beneath the level of the bars, a position which has several advantages for the action in view. When the pivot is on the level of the grate, the chord of the arc described at each end is vertical. But the depression of the axis renders the working curves segments of a more horizontal portion of the circle. Hence, the curved plate on the dead plate will offer less obstruction in front of the bars, its upper limb supporting the hopper will project more over the fire during feeding, and from the curve lying behind the hopper there will be no chance of small pieces of coal falling in to obstruct the action of the grate. The similar curve at the back end of the grate will effect the admission of air with a much smaller vertical rise of the bars and air-plate towards the bridge. This rise into the fire may obviously be further diminished by setting the pivot backwards. The hinder radius will then describe a still more horizontal curve. But as a general rule, it will be convenient to place the pivot as far backwards as will bring the front end of the grate into counterpoise with the weight of the perforated plate on the hinder extremity. Instead of a frame work, the bars in fig. 2 are supported by bearers, dropped into notches across the heads of the arms which proceed from the centre of oscillation. This arrangement obviates the longitudinal expansion of a frame parallel with the bars in proximity to the fire. When the bars in more than one length require more bearers, further support will, of course, be needed, and in any case a light bevelled plate should guard the outside of the arms, close against the furnace walls. Fig. 3 shows the same provision for supplying air between the fire and the bridge, but a different and very simple detail in front. Those who prefer heating anthracite on the dead plate before throwing it on the fire, will find this a very convenient furnace, with the freest access of air, as the dead plate and curved plate of fig. 2 are absent. The hopper or feed plate is balanced in two eyes, fixed in the side walls of the furnace, immediately under the swing door which admits the fuel. When the grate is in its proper position, this plate fills the office of a dead plate, its inner edge resting on a plate or ledge projecting from the end of the grate frame or bearer. The centres of rotation of this plate and of the grate are so respectively situated that their curves touch in this position, and continue to intersect as they descend lower. The edge of the hopper plate can, therefore, move freely to a higher level, but it is carried down by the bevelled edge of the grate frame when descending, thus tilting the coals on the reverse radius of the hopper, without the need of levers or fixed connections, as in fig. 2. When the grate is brought up to its level a considerable heap of coals will remain resting on the dead plate end of the hopper, and these, by a jerk, can be at any time thrown off on to the fire, with but a momentary admission of air between the then parted plate and grate. The action may be enhanced by raising the axis of the dead plate a few inches, to give it a permanent inclination towards the grate. The pushing of the incandescent fuel to the back end is likewise greatly facilitated by this arrangement.

When this is to be done the grate is raised to the upper dotted lines. The hopper plate sliding on the end of the grate-frame continues to prevent the improper admission of air, and an inclined plane is obtained, down which, by inserting a tool through a suitable hole above the swing-door, the hot coke can be carried backwards with great facility, and the fire completely levelled, before charging another feed upon the front. The under edge of the clinker-plate must be guarded to a sufficient depth to prevent the fuel falling through when the back end of the bars is depressed. To introduce the same facility for stoking into the arrangement, fig. 2, it will be necessary to attach a curved plate to the front end of the grate, as shown by the dotted line, to exclude air during the elevation. This plate will lie within and against the curved dead plate when the grate is in a permanent position, but it is an encumbrance, which fig. 3 is especially designed to avoid. The tool for this operation of levelling may be a bar of iron, resting in a niche inside the top of the plate over the swing door—it will be away from the fire; the handle having a joint outside to double it into a convenient position when not in use, will pass through a hole of its own size, so that there will be nothing to be opened when it is applied. One stroke of this tool along the inclined plane will level the fire from end to end. Operations of greater nicety are effected in the iron manufacture by skilful workmen in the interior of closed furnaces; but if a hole is preferred, a very small rake indeed will effect a speedy adjustment.

I have a variety of other arrangements, some calculated to feed the coal further into the furnace when desirable. For instance, by a trifling modification, the hopper-plate in fig. 2 may be carried inwards as well as upwards, so as to deliver the coal nearly to the back end of the grate, and this action may also be applied to fig. 1, as a substitute for the hopper delineated. A very efficient variety of action may be given to the extreme simplicity of the charging plates in fig. 3, and in each of these examples the hoppers may be so adjusted that the motion of the grate will lift the charge from the level of the floor. But these are refinements on the demands of ordinary practice. The instances, as they stand, carry into effect two important principles; first, a supply of fuel without opening the front of the furnace, dependent on one single motion upon one strong working part, and not on the motion of a multitude of ingenious and derangeable parts; and secondly, a simultaneous supply of air, exactly proportioned to the extra demand made by the cold fuel on the capacities of the furnace. The labour of the fireman is diminished to the same amount as in the mechanical feeding furnaces—namely, to filling the coal into a hopper at a low level, and I am not certain that the attention and care in dressing and levelling the coal roughly introduced, will be at all more exacting than I have seen bestowed on the process of some of these. I may shortly furnish you with some other varieties for special uses, particularly a powerful "smoke-consumer," being fitted to boilers with the grate in a cylindrical tube, the circle being there already supplied for lateral, and not longitudinal oscillation. In fact, the great scope which such a novel motion affords has rendered it, *ad interim*, an excellent time-consumer in classifying its applications. To furnish coal to the air passing the bars in a constantly equable proportion, precisely as oil or other liquid flows to the demands of a lamp, is without doubt the most perfect system, could it be effectually realised. But the difficulties in treating the rough material of coal as a fluid have proved very great, and involve so much expensive complication, notwithstanding the mass of ingenuity brought to bear on the subject, and the interesting results actually obtained, that I have been led to try another system of attack, by shorter and more unencumbered approaches, susceptible at least of greater power, if of less nicety of perfection; a rough cutting of the knot which so many have delicately untied. I lay no claim to the admission of air in small streams; I adopt it as a well-tried and scientific necessity; casually and imperfectly used here and there for 50 years, the theory of its efficient use has been so entirely developed in the minute, elaborate, and comprehensive disquisitions of Mr. C. Wye Williams, and practically applied by him in so universal a manner, that it seems to me there remains as much ground for novelty in introducing air at the bars as at any other part of the furnace. Whatever novelty I have in this respect is not in the admission of air, but in the addition of new parts for its entry, and their motion by which it enters.

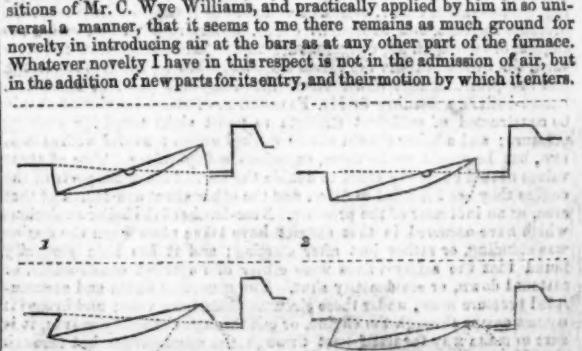


Fig. 4 gives a comparative view of the position of the back end of the bars in their elevation towards the bridge under four different positions of the centre of oscillation, the depression in front being equal in each instance. It is obvious that the narrow throat under the boiler, in the first position, loaded with incandescent fuel, over which the gases from the

front must pass before they encounter the cold air streaming up behind the perforated plate, will prove a powerful—nay, violent—smoke annihilator. The ends of the bars are not in the fire; the cold air is below them and behind them; they are not under the trial of a single bar, which, when lifted from its seat, has fire on three sides of it, and is rapidly burned; but, nevertheless, they are in the line of the draught to the bridge, and the current of heat will pass along them instead of vertically from them, which is the great advantage obtained by inclining the floor of bars towards the bridge. The bars, therefore, would undoubtedly be prejudiced, if left in this position after the fresh charge is thoroughly ignited, and as the astonishing power of the arrangement might prove a temptation to prolong its effects, I recommend the other forms for general adoption. Those who have careful men to depend on may appropriate the great capacities of the first example; as a further protection, a row of fire-tile or brick, well fitted on the hind bearer, may form the surface of the extremity of the grate; and a damper, suspended on an axis behind the bridge, and gradually raised by the action of the grate, so as at last to come flat against the lower half of the bridge passage, will permit of the elevation of the bars being longer continued with safety, with but a trifling diminution of the specific effect; when such a damper is used, checking the velocity of the current, the perforations may be increased, as, for instance, by perforating the front plate, A (Fig. 2). All the working edges must be bevelled underneath away from the curves and the walls, to keep them clear of small coal and dust. It is obvious that the charging motion, at stated intervals, may be imparted from the engine instead of by manual effort, if preferred; this may be done in Fig. 1 with the greatest facility. In Figs. 2 and 3 the prism of coal charged in the front of the grate, thin towards the fire, and thickening towards the dead plate, is especially conducive to a graduated and moderate process of combustion. For especial nicety, a few ribs, properly disposed on the face of the hopper plate, divide the mass of coal, and lead it uniformly down. In a word, of the diagrams in Fig. 4, No. 1 shows the best consumer; No. 4, the best feeder; the other two are intermediate compounds. The *rationale* of feeding in all the figures is to admit the coal gradually, or even intermittently, when convenience permits, giving time for completely commencing the distillation of each succeeding portion of the charge. DAVID MUSHET.

STEAM-BOILER EXPLOSIONS—MR. FAIRBAIRN'S EXPERIMENTS—PROPOSED ASSOCIATIONS FOR THEIR PREVENTION.

The emphatic declaration of the jury, in a remonstrance appended to their verdict, at the recent inquest, held at Rochdale, on the bodies of the ten victims to the boiler explosion at Mr. G. WILLIAMSON'S weaving sheds in the Bidgefield Mill, near that town, that they could not "separate without pressing on the consideration of the owners and users of steam-boilers throughout the kingdom the necessity there is that measures should be taken by them to ensure a thorough and frequent inspection of boilers, so as to prevent, as far as human foresight can, the recurrence of explosions," demands from us a special notice of the probable cause of that tragic occurrence. Peculiar interest is attached to the enquiry, from the fact that Mr. WILLIAM FAIRBAIRN, the justly-celebrated engineer, at the solicitation of the coroner and jury, visited the scene of the accident, inspected the premises, and investigated the origin of the catastrophe. His report and evidence, therefore, furnish a valuable commentary on the proper regulations of steam-boilers, and may be considered a premonitory essay on the shameless ignorance and frightful recklessness which, we fear, are too often displayed in their management. He describes his finding the buildings, steam engine, boiler, and machinery, a heap of ruins; the boiler torn into eight or ten pieces; one portion of the cylindrical part flattened and embedded at a considerable depth in the rubbish; the two hemispherical ends burst asunder, and driven in opposite directions to a distance of 30 to 35 ft. from the original seating of the boiler. Other parts of the cylinder were projected over the buildings, and lodged in a field distant 90 yards from the point of projection; to one of which parts had been originally attached the 2-in. safety-valve, which was torn from the boiler by the force of the explosion, and carried along with its seating over a rising ground to a distance of nearly 250 yards. The other portion of the cylindrical part of the boiler was found on the opposite side in the bed of the river; and the hemispherical end of this part furthest from the furnace was rent in two, and thrown on each side to a distance of 30 or 35 ft. These two pieces had evidently come in contact with the chimney, razed it to the ground, and finally lodged themselves on the margin of the river; while the 3-in. safety-valve and pipe attached to that portion of the boiler imbedded in the river was broken from the flange; and with an extended range the 2-in. valve was projected over the river into a meadow at a distance of from 150 to 200 yards. Of the steam-engine not a vestige was to be seen, except the fly-wheel and a pump rod, beside it was covered with bricks. The springing of a mine could not have been more destructive than this explosion; and we are thus enabled to judge of its terrific force.

The task of arriving at the extent of its violence was attended with many difficulties, arising from the want of an accurate knowledge of the state of the safety-valves, the density of the steam at the moment of rupture, and the ultimate strength of the boiler. Mr. FAIRBAIRN, accordingly, entered into a few comparisons, which he conceived would be useful to those entrusted with the management of boilers, and the employment of steam of increased density and great elastic power. Gunpowder is calculated to impel a body with a force 244 times greater than the pressure of the atmosphere, which, taken at 15 lbs., gives $244 \times 15 = 3669$ lbs. as the force upon a square inch of surface—being nearly 30 tons upon a piece of ordnance of 6 in. calibre. Bullets discharged with this force, augmented by the elastic power derived from the heat generated in firing gunpowder, will leave the muzzle of the gun at a velocity of 1700 ft. per second, or nearly 20 miles a minute; and although the effects of boilers bursting with high-pressure steam may not be equally appalling, they are, nevertheless, sufficiently so to be placed in the same category as engines of destruction, and ought to be treated in the same manner and with the same precaution.

Mr. FAIRBAIRN found the boiler in question with hemispheric ends 18 ft. long, 5 ft. diameter, and composed of plates supposed to be 5-16ths of an inch thick—a thickness equal to a pressure of 335 lbs. on the square inch; but one of the plates being under 5-16ths in thickness, and as the thinnest part is the measure of the strength of the boiler, he reduced its power to 300 lbs., which he considered the force at which it would burst. Taking 300 lbs. as the pressure on every square inch of the surface, and the superficies at 41,000 in., there was pent up in this comparatively small space the enormous force of $41{,}000 \times 300 = 12{,}300{,}000$ lbs., or 5491 tons of elastic force compressed in an iron case of little more than a quarter of an inch in thickness.

The relative volume of steam at the pressure of the atmosphere is 1700 times that of water. At higher temperatures, and increased density, the volume is reduced in a given ratio of its temperature and density; and it is impossible to increase the temperature without increasing the pressure. In boilers having an active fire burning under them, the engine standing, safety-valves fast, it matters not how, the temperature will rise, the pressure increase, and explosions ensue, unless relieved by starting the engine, or letting off the dangerous accumulation of temperature and pressure; for which purpose the valves must be looked to, the fires regulated, and the pressure kept down below the dangerous point of resistance. Steam-boilers, according to Mr. FAIRBAIRN, of every description should be constructed of sufficient strength to resist eight times the working pressure; and a boiler should not be worked unless provided with at least two, but he would prefer three, capacious safety-valves. Two of these valves should be nearly equal to double the area of the steam ports of the engine they are intended to drive, and the other about one-fourth of that area, as an indicator of the pressure. Nine-tenths of the boiler explosions which have occurred in that district have taken place when the engine was standing, or rather just after starting; and it has been generally found that the safety-valves were either of imperfect construction, or fastened down, or accidentally shut. The generated steam and accumulated pressure must, under these circumstances, have vent; and in case it cannot escape through the engine, or out through the safety-valves, it is sure to make way for itself—not through the usual outlets, but through the sides, ends, or bottom of the boiler. It has been asserted that explosive gas is generated in several cases where explosions occurred; but Mr. FAIRBAIRN utterly repudiated the notion, being satisfied from experience and long observation that gas had nothing to do with them—that they were governed by a fixed and determined physical law, and that law is neither more nor less than excessive pressure. In cases where boilers explode from want of water, and the plates become red-hot, then and then only does the spheroidical theory of BOUTIGNY come into operation, in which instances large globules of water, containing immense central heat, are formed, and bursting with great force and a loud report, might rupture the vessel in which they are contained. This could not, however, take place unless water is pumped into the boiler suddenly, and without reflection as to the results; and he was of opinion that accidents of this description seldom, if ever, occur. This lucid explanation of the theory will, we trust, prove a salutary precaution to proprietors not to confide such dangerous engines of destruction to ignorant and incompetent workmen, for whose acts and incapacity they are, according to the law as laid down in the House of Lords, referred to in our last week's Journal, most clearly responsible.

Applying this theory to the facts of the present lamentable case, Mr. FAIRBAIRN came to the conclusion that such a boiler as that of Mr. WILLIAMSON'S ought not to be worked with a pressure much above 40 lbs. to the square foot, and certainly not exceeding 50 lbs. It was difficult in this case, from the deficiency of the evidence, to ascertain the exact pressure; but, from the weights which had been placed upon the valves, it was necessarily excessive. In the course of his examination, Mr. FAIRBAIRN further stated, that mercurial guages could not always be relied on, and were not in every instance correct indicators of pressure. He illustrated this by observing, that in the experiments, to which we subsequently refer, he had used two such guages, and found a difference of 10 lbs. between the pressure they severally indicated, with which, being of course dissatisfied, he was obliged to get columns of mercury, so as to check them, and bring them to a standard.

In answer to a question whether he conceived that one of the two valves ought to be out of the control of the engineer—whether, in fact, there should be an inside valve, or one weighted from the inside, Mr. FAIRBAIRN replied that he had been once favourable to the use of lock-up valves, because he thought that they could not be tampered with. He declared, however, that he since had reason to change his opinion, and he now believed that valves completely exposed were the safer, either having a dead weight on them, or with levers in front, so that any person could see them. He once had valves on the top of the boiler, so cased up with a hood over them, that although the steam could escape through something like a Venetian blind, not even a stick or a piece of wire could be put through to tamper with the fittings. There was a pulley lever through the stuffing-box, by which the engineers were able to lift the valve, and there was plenty of room for everything to work freely. On board the navy steamers, they use the lock-up valves; but it is the duty of the chief engineer to report daily as to the state of the valves, as regularly as the log of the vessel is kept. Mr. FAIRBAIRN was pressed to say whether he considered it an advantage to have a valve locked up, or weighted from the inside of the boiler; to which he replied, that it was a difficult question to deal with, but that he had already given his opinion.

Mr. FAIRBAIRN also submitted the following tabular results of some experiments which he had made in order to ascertain the force which steam acquires in a comparatively short period of time when the engine is at rest, and the usual outlets for escape are closed:—

Time in minutes.	Pressure in lbs.	Temp. Degrees.	Volume.
0	11·75	243·00	980
1	14·15	246·75	906
2	16·35	251·00	846
3	19·25	255·25	782
4	22·35	259·75	720
5	25·75	264·00	665
6	28·95	268·37	621
7	32·15	273·00	582
8	35·75	277·00	545
9	39·95	282·00	506
10	44·25	286·87	472
11	48·35	291·50	445
12	52·75	295·37	418
13	57·75	300·00	392
14	63·75	304·25	365
15	68·95	308·75	344
16	74·75	313·00	324
17	80·35	317·75	306
18	87·25	322·00	288
19	93·95	326·12	273
20	101·15	331·00	257
21	108·75	335·62	243
22	112·00	337·00	This experiment lost.

These experiments were made with a boiler prepared for the purpose; and it will be seen that the steam which was at starting 11·75 lbs. on the square inch, increased in density to nearly four times the pressure, and in 10 minutes more it was nearly nine times; that it continued to increase in an accelerated ratio, until in less than 20 minutes, had he been able to continue the pressure, it would have reached a point beyond all powers of resistance, when explosion must have been the result.

The rest of the evidence was very unsatisfactory and inconclusive. WILLIAM TAYLOR, the man who was proved to have placed heavy weights upon the valves, was dead—one of the victims of his own imprudence. The verdict may be fairly taken as the result:—

"That, in the opinion of the jury, the death of ANN SCOTT, and nine other persons, was caused by an explosion of the boiler, at Bridgefield mill, occupied by George Williamson, such explosion being occasioned by an excessive pressure of steam, and that pressure being produced by the following circumstances:—First, the 3-inch safety-valve not being in working order, and consequently inactive; secondly, the 2-inch safety-valve being, on the morning of the explosion, much over weighted; and, thirdly, as the engine only worked at intervals from six o'clock till 20 minutes past, a space of time elapsed during which the fire was kept up, and in that time such an amount of heat was added to the water in the boiler, and pressure thereby accumulated, as to render it impossible that the boiler could be relieved by the small or 2-inch valve when so overweighted. The jury at the same time wish to express their opinion that the boiler and engine at Bridgefield mill were very improperly managed, thereby causing danger to the parties employed; and that the occupier and engineer are exceedingly blameable for working the boiler at the high pressure they have done for a long time previous to the explosion."

Mr. FAIRBAIRN intimated his conviction, that the frequent recurrence of these lamentable catastrophes would be very likely to lead to the enactment of some very stringent laws for the protection of the lives of the community. He suggested it was possible, and, indeed, quite practicable, to establish associations in the several districts, the members of which should appoint inspectors to take cognizance of the boilers within their respective precincts, and to report to the association weekly in what state they found them, and the causes which prevented them from being in working order, if the inspector should consider such to be the case. He did not conceive that it would be any tax on the proprietors of boilers to pay a trifling sum yearly to meet the expenses of such an association; for it struck him forcibly that, in addition to preventing those very serious accidents, it would be productive of benefit to the proprietors themselves, and save a great deal of money, which is now lost by the frequent explosions. It is observable that, in this case, Mr. WILLIAMSON, the owner of the boiler in question, prudently declined making any observations to the jury. Mr. FAIRBAIRN, although he declared that he did not speak of Mr. WILLIAMSON individually, or with any intention of prejudicing him in the minds of the jury, distinctly stated his belief, "that both Mr. WILLIAMSON and his engineer are ignorant of the proportions of steam, and the care that is necessary for retaining it within bounds of control;" and still this gentleman, standing in the light of a man to some extent accountable for ten homicides, had no statement to make, and avowed that he did not intend to call any witnesses. The voluntary inspection suggested by Mr. FAIRBAIRN may, perhaps, tend to prevent some accidents; but with such millowners as Mr. WILLIAMSON, and we fear that they are numerous, a power of inspection would be valueless which is not authorised summarily to enforce its recommendations.

Since the above observations were written, we perceive that Mr. FAIRBAIRN'S earnest recommendation has been adopted, and that an association has been formed in the district, for the inspection of steam-boilers, and the prevention of boiler explosions. We cannot avoid anticipating from it the best results, and we entertain a strong opinion that his valuable suggestion may be also successfully applied to coal mines. A voluntary and self-supporting system of inspection, introduced by the proprietors of collieries, and sustained by contributions amongst themselves, would probably save many lives, and tend to prevent much consequent expense, always necessarily attendant on the sacrifice of men by explosions of fire-damp. We feel really sick at heart at being obliged constantly to recur to these tragic catastrophes. Our Journal lately recorded another terrific explosion at the Lund Hill Colliery, Hemingfield, by which four men were killed, and two severely mutilated. We this day record another similar fatality, an explosion of fire-damp at the colliery of Messrs. A. KNOWLES and SONS, Clifton, near Manchester, in which two men were killed, and four severely burnt. The cause is, in both instances, traceable to the use of naked candles in highly fiery mines; and when we all feel that the limited number of Government Inspectors wholly precludes them from the possibility of providing against every neglect, few will, we think, dissent from us in the views we express—that a local and private system of inspection would be attended with the most beneficial consequences.

MERCANTILE LAW COMMISSION—SCOTCH COMMERCIAL LAW CONTRASTED WITH ENGLISH.

The many and pressing claims upon our space have hitherto prevented us from resuming the consideration of a subject at this moment of great importance to the mining and mercantile community. We refer to the enquiries instituted by the commissioners appointed by the Crown to consider the propriety and practicability of assimilating the commercial law of England, Scotland, and Ireland. These enquiries, under the head of "Mercantile Law Commission," are in progress; in our Journal of the 29th of July last, we called attention to some of the striking differences which exist on certain points; and we now proceed to point out those which still prevail on the following important ones:—1st, in the state of the law of debtor and surety, or, as the latter is termed, cautioner, in Scotland; 2d, in the state of the law of debtor and creditor; 3d, in that of the law of private partnerships; and 4th, in that of joint-stock companies.

In England or Ireland, where an engagement by principal and surety is joint, the creditor must institute proceedings against both, but is at liberty to enforce payment against either—if against the surety, such surety is left to adjust with his principal, or co-sureties, if more than one, his rights to be indemnified, and to contribution; while, in Scotland, the cautioner is entitled to have the principal, in the first instance, compelled to perform the obligation, so far as the creditor can enforce it. Again, the surety cannot, by our law, have the benefit, against the principal debtor or his co-sureties, of securities which are extinguished by such performance; while, in Scotland, the cautioner, on performing the obligation, is entitled to an assignment of the creditor's claim, and of all securities. An unqualified discharge of one surety is, with us, a discharge of all; by the Scottish law, it is only a discharge of a co-cautioner to the extent of the proportion which the one discharged should have contributed to the relief of the others. Our remedies against sureties cease at the end of six, or twenty years from the time at which the right to sue accrued, according to the nature of the instrument; while the liability of a cautioner, in Scotland, ceases at the end of seven years from the date of the obligation. In our courts, assets are divisible into legal and equitable—in the administration of legal assets, debts of record, and by specialty being of a higher degree, must be paid before those of a lower degree, such as by simple contract; while in the administration of equitable assets, all debts are payable *pari passu*. In Scotland, there is no distinction between legal and equitable assets, and all debts, of every description, are payable equally out of all real and moveable property of the debtor. Creditors of a deceased debtor may, by a suit in Chancery, with us, the heir or devisee being a party, obtain payment of their debts out of his real estate at any time previous to alienation by the heir or devisee; while, in Scotland, this privilege ceases after three years, and the proper creditors of the heir may thereafter stand on a par with those of the deceased. By our law, an executor or administrator may retain out of equitable assets, for a debt due to himself only, in the same right with other creditors; out of legal assets, only in preference to all other creditors of an equal or inferior degree, and he cannot retain for a contingent or unliquidated debt due to himself. In Scotland, the right of retainer enables the personal representative to secure himself against engagements undertaken for the deceased, and not yet broken. With us, he may, before proceedings are commenced, pay any creditor in full, in preference to all other creditors of equal or inferior degree; while, with them, he cannot prefer any creditor over all those who claim within six months after the debtor's death. There are a variety of other minor distinctions, and, without entering into the enquiry, or discussing which course of practice ought to be preferred, few will dissent from the opinion that an assimilation is in the highest degree desirable.

The differences are very distinctive between the laws of the two countries, in respect of private partnerships. With us, a private partnership of two or more persons is not recognised in law separated from the associated individuals who compose it, and a private partnership cannot sue or be sued by any of its members, except in a court of equity; while, in Scotland, a private partnership or company, of one or more members, is a *separate person* in law, and a private partnership can sue and be sued by any of its members. Two private partnerships, having one or more members in common, cannot, with us, sue each other, except in a court of equity; while two private partnerships, having one or more members in common, may sue each other in Scotland. The regulations as to bankruptcy seem to vary very materially—distinctions which must necessarily prove detrimental to the trading relations between the countries. There is, however, a striking contrast between the powers of partners. By our laws, pending an action or suit by co-partners, one or more of them may gratuitously release the defendant from the whole cause of action or suit, and a defence, valid against one co-partner, is available against all; while, in Scotland, pending a suit by a company, one partner cannot release; and a defence, although valid against one member of a partnership, would not be available against the company or the other partners. Again, a partner in Scotland may, in general, bind his co-partners in any form in which he can bind himself; while, with us, a partner cannot generally bind his co-partners by instrument under seal. There are similar discrepancies in respect of the law of sett-off, in reference to the failure and dissolution of co-partnerships, and in relation to the retiring of dormant partners, which, in the present state of our close commercial connection, render it impossible for professional men at either side of the Tweed to advise safely as to mercantile transactions occurring at the other. These distinctions are too refined—they tend to embarrass commercial transactions, and in a state under the same Crown, governed by the same Administration, and legislated for by the same Houses of Parliament, they ought not to be permitted longer to exist.

In England and Ireland, all commercial joint-stock companies with tranferable shares, and all partnerships consisting of more than 25 members, not formed under any special Act of Parliament or letters patent (except mining associations on the Cost-book Principle, and anonymous partnerships in Ireland, under 21 and 22 GEO. III., c. 46, 2), must be registered, and make periodical returns as by law required; while, by the common law in Scotland, joint-stock associations with transferable shares are legal without the authority of the Legislature, or the Crown, or the Board of Trade, and without registration, with the exception of banking companies established since the 9th of August, 1845, and Scottish joint-stock companies having a place of business in any other part of the United Kingdom. Previous to provisional registration with us, there is a prohibition, amongst other things, against taking any money for shares allotted or to be allotted, issuing in the name or on behalf of the company any writing denoting a right, claim, preference, or promise to any shares, advertising the existence or proposed formation of the company, and making any contract for or on behalf the intended company. Previous to complete registration, there is a prohibition against making calls, except for the purpose of deposits, and against purchasing, contracting, or holding lands, or entering into contracts, except conditionally, or for matters required for the establishment of the company, and also against the disposal of shares until registration of the owner as shareholder. These several matters, so prohibited here, are not illegal in Scotland, except in the instances to which we have above referred. Before complete registration, a deed of settlement, containing the statutable requirements, must be executed by at least one-fourth in number of the persons who have then become subscribers, holding at least one-fourth of the maximum number of shares in the capital of the company; while such a deed of settlement is not required in Scotland, unless the company has also a place of business elsewhere in the United Kingdom. Upon complete registration, every company with us becomes incorporated by the name of the company set forth in the deed, for the purpose of carrying on the trade or business for which it was formed, and for the purpose of suing or being sued in its corporate name; while, in Scotland, a joint-stock company, not incorporated, cannot sue or be sued in its assumed name, unless three or more of the partners be joined with the company itself in the suit. A judgment, decree, or order, against a company completely registered has, with us, no effect against a former shareholder after the expiration of three years from the time when he ceased to be so; while, in Scotland, persons who were members of a company when a debt was contracted continue liable indefinitely, although they cease to be members by the transfer of their shares. Shares in joint-stock companies, generally, and specially under the "Companies Clauses Consolidation Act," are, in England and Ireland, transferable by deed under seal only; while, under the same Act, in Scot-

and, shares are transferable by deed with or without seal, such being the general law in Scotland, if not otherwise prescribed by the terms of the Copartnery. Our readers are fully aware of the several Winding-up Acts, their provisions, operation, and effect: they do not apply to Scotland; but although there is no Winding-up Act in that country, the Court of Session has authority to appoint a judicial factor, who possesses powers somewhat similar to those conferred by, and exercised under them.

A knowledge of this contrast of the state of commercial law must be peculiarly useful at the present period, when the question of limited liability occupies so much of the public attention, and is destined, in the next session of Parliament, to occupy much more. Towards the close of their sittings, the President of the Council, in reply to a question, stated that the matter, and the measure for regulating it, were then under the consideration of the Government; and, as it is highly desirable that any law to be passed should be as perfect as possible, those whose knowledge, opportunities, and practical experience of the working of public companies, enable them to afford information, and to put forward useful suggestions, should bend their minds and apply their energies to the consideration of the subject. They should remember that, although in Ireland, under the anonymous partnership—a measure felt and admitted to be imperfect and unsatisfactory—partnerships may be formed without the sanction of Parliament, the Crown, or the Board of Trade, in which non-acting partners may enjoy limited liability in respect of partnership engagements, yet, in England and Scotland, limited liability on the part of individual members for partnership engagements can be enjoyed only when it is expressly stipulated for in the particular engagement itself, or when it is conferred by special authority of Parliament, or of the Crown, or of the Board of Trade.

CHARTERED COMPANIES—DEED OF SETTLEMENT—FORFEITURE OF SHARES.

An important judgment was delivered in the Court of the Lords Justices of Appeal, on Thursday, the 27th of July last, in the case of NORMAN v. MITCHELL, relating to the Chartered Bank of India, Australia, and China. It involved very serious questions, and had besides this peculiarity, that it was a suit instituted on behalf of the general members of a joint-stock association, incorporated by Royal Charter, against the governing body, impeaching that charter and seeking to revoke or remodel it, and also to rectify the Deed of Settlement, which had received the sanction of the Lords of the Board of Trade, in obedience to the commands of the Crown. The motion had been originally in form an appeal from the MASTER OF THE ROLLS, but it had now, by the amendment of the bill, and from other causes, been converted into a substantive application to the Lords Justices for an injunction. The Court, impressed with the interest attached to the case, requested the assistance of two of the common law judges, and accordingly Justices ERLE and CRESSWELL sat with them during the discussion. The bill was filed by the plaintiffs on behalf of themselves and all other subscribers to the company, except such as were defendants, against the directors and trustees of the bank, and prayed an account of dealings with shares; that the directors might be rendered liable on the subscription contract equally with the other subscribers; that a proper Deed of Settlement might be prepared under the direction of the Court; that the provisions of the Charter might be declared not to be binding, except in so far as they agree with the subscription contract; that the directors might be ordered to apply to the Crown to have the same rectified so as to be conformable therewith; that a forfeiture of the plaintiff's shares, made on the 25th May last, might be declared void; and that until the new Deed of Settlement should be executed, the directors should be restrained from opening any branch banks, or otherwise acting contrary to the subscription contract or the charter, so far as it was binding; from enforcing any calls, from forfeiting any shares, either from non-payment of calls, or not executing the present deed, and that the trustees should be also restrained from executing same in the plaintiffs' names.

In October, 1852, a prospectus was issued, proposing the formation of a company with a capital of 1,000,000*l.*, in 50,000 shares of 20*l.* each, for banking in the Australian Colonies, British India, China, and other parts of the Eastern Archipelago, one moiety to be paid up, with power to the Directors to increase such capital to the extent of 3,000,000*l.* when necessary, by the issue of additional shares, which should, in the first instance, be offered to the existing proprietors at the time, in proportion to the shares they should then hold. A deposit of 10 per cent. would be required at the time of allotment, and 8*l.* per share on the moiety of the capital, by instalments, when called for by the directors. A Royal Charter was to be applied for, with limited liability; if procured, business was to commence immediately—if refused, the deposits were to be returned in full. The constitution of the company to be embodied in a Deed of Settlement, to be approved by the Committee of Council for Trade, and any shareholder who should not sign it within a month after public notice, should forfeit his shares with the deposits paid thereon. The plaintiffs alleged, that relying on the prospectus they had applied for shares, and given the usual undertaking to pay calls and sign the Deed of Settlement when required. The directors reserved 18,000 shares, set apart 10,000 to themselves, and allotted 22,000 amongst the general applicants. A deed, called the subscribers' contract, dated the 16th of November, 1852, was made between the subscribers of the one part, and the trustees on the other, and it appeared to conform to the terms of the prospectus; while, in addition, it contained a number of special provisoes, and charges were made against the directors as to their personal conduct in respect of the contract. A petition was duly presented for a charter, which contained the following allegation:—"That the capital is to be of the amount of 1,000,000*l.* sterling, to be raised by 50,000 shares of 20*l.* each, and a further sum, making a total capital not exceeding 3,000,000*l.* sterling." A charter dated the 29th December, 1853, was granted, which recited that it had been represented to her MAJESTY that parties had associated to establish the bank, "for which purpose they have agreed to subscribe a capital of 644,000*l.*, in 32,200 shares, of 20*l.* each, and with power to raise a further sum not exceeding 2,000,000*l.* in addition." The charter then constituted the defendants, and all who should become proprietors of shares, a corporate company, by the style of the "Chartered Bank of India, Australia, and China." That document, amongst other provisions, declared that it should not be lawful for the company to commence banking until the entire capital of 644,000*l.* had been subscribed, and one-half at least paid; and further, that if the whole was not subscribed within 18 months the charter should be void. The charter, amongst further provisions, contained the following:—"And further, we declare that it shall be lawful for the directors of the said company, with the consent previously obtained of the Commissioners for the time being of our Treasury, from time to time to extend their said capital to any sum not exceeding in the whole, with the said sum of 644,000*l.*, the sum of 1,000,000*l.*" Thus the prospectus, the subscription contract, and the petition for the charter, agreed that the capital was to be 1,000,000*l.*, to be increased, if need be, to 3,000,000*l.*; while the charter resiting that the parties had agreed to subscribe a capital of 644,000*l.*, with power to raise it to a sum of 2,000,000*l.*, gave power only to raise the additional capital to 1,000,000*l.*, including the 644,000*l.* The Deed of Settlement of the company was dated the 20th of March, 1854, and amongst its provisions contained one departing from the charter as to the capital and its increase by contemplating the raising of 2,000,000*l.* over and above the highest amount thereby authorised. The Deed of Settlement was approved of by the Treasury after the 16th of March; but previously, on the 17th of February, a call of 2*l.* per share had been made, to be paid up on or before the 20th of March, being the call for the shares for which each subscriber had signed the subscription contract; and the notice further stated that the Deed of Settlement would be ready for signature at the office of the company on the same 20th of March. On the 7th of April a further notice was issued, that all shares on which the call of 2*l.* per share should not be paid would be forfeited, and the shares of the plaintiffs were accordingly, on 25th May, declared forfeited, the owners thereof having refused, or neglected, to execute the Deed of Settlement.

Upon these materials the appeal motion was argued, and it was contended on the part of the general body of shareholders that they were only bound by the prospectus and subscription contract, and that the charter being a departure from both, conferred no powers upon the directors. Further, that the Deed of Settlement being a departure from all three, that they were not bound to execute it, but were entitled to have the charter and the deed made conformable to the contracts. The following questions were arranged and stated, to be argued before the Lords Justices and the Common Law Judges:—1. Have the defendants, the present directors, now, and have they ever since the date of the subscription contract, or during any, and what part of the time, had the powers and authorities intended to be given to directors by the subscription deed?—2. Were the plaintiffs, on or before the 20th of May last, liable to pay the calls?—3. Is the Deed of Settlement, as now prepared and settled, conclusively binding on the subscribers to the subscription contract?—4. Have the defendants the power, in the event of a subscriber to the contract neglecting or refusing to execute the Deed of Settlement as prepared and settled, to forfeit his shares, and were the shares of the defendants duly forfeited by the resolution of the 25th of May last? The arguments on these questions occupied several days, and a number of the clauses in the deeds and charter were relied on at both sides.

Lord Justice KNIGHT BRUCE commenced delivering the judgment of the Court by reading, at length, the opinions of the law judges on the several questions submitted to and argued before them. They were both of opinion that the directors had the powers and authorities intended to be given to directors by the subscribers' agreement, and that they were thereby appointed directors until the charter should be obtained. It had, however, been argued that their authority ceased the moment the charter was sealed; but if the powers of the directors were to cease altogether on the granting of the charter, it would be impossible for them to do certain things which the agreement in express terms authorised them to do; amongst others, no provision existed for appointing directors, except that contained in the subscription contract. The Common Law Judges were, therefore, of opinion, that notwithstanding the word *until*, the powers intended to be given by the subscribers' contract would continue until superseded by the Deed of Settlement. The answer to the first question, therefore, was, that as regarded the plaintiffs, who had not given up their scrip receipts, the defendants, the present directors, have now, and ever since the date of the subscription contract have had, the powers and authorities thereby intended to be given to directors. As to the second question, assuming that the directors had those powers, the Common Law Judges conceived that the plaintiffs were, before the 25th of May, liable to pay the call, the subscribers contract having given the directors power to make a call as soon as the charter should have been sealed. The charter was sealed before that day, and the plaintiffs claimed as members of a corporate body created by that charter, it was difficult, therefore, to understand how they could resist the payment of the calls on account of any supposed objection to the charter. It had not been contended that the charter could be treated as a nullity, but two objections had been taken to it; first, that it had been granted on false representations, and might, therefore, be repealed by *scire facias*; and, secondly, that the capital authorised by it to be raised varied from that which the subscription contract had provided should be the capital of the company. The charter did not appear to the judges to be open to either of these objections, for they could not say that any deception had been practised on the Crown which would render the charter void or voidable; and it was not alleged that the plaintiffs had not authorised the defendants to accept the charter. They were, therefore, of opinion that before the call in question an event had happened which entitled the directors to make the call; the answer to the second question was, therefore, in the affirmative. In respect to the third question, whether the Deed of Settlement was binding, both the subscription contract and the charter required this deed to be prepared and executed to the satisfaction of the Treasury, and when executed to be the deed of the company, unless repugnant to the laws of the realm, or of the colonies in which the business may be carried on; and they were of opinion that such deed, when duly sanctioned, must be considered as incorporated with the charter, binding upon the original subscribers; that, therefore, the objections to the deed had failed, and that the members of the company were bound to execute it. The fourth question had reference to the power of the directors to declare the shares forfeited. The subscribers' agreement gave power of forfeiture for non-execution of the deed after one month's notice, but it contained no power to declare the shares forfeited for non-payment of the calls; but, from the notices as to the deed being ready, and requiring the call, it must be assumed that the subscribers were given to understand that they must first pay the call and then execute the deed. As this would be in effect to declare the shares forfeited for non-payment of the call, which was not within the power of the directors, the judges were of opinion that the shares had not been duly forfeited. Lord Justice KNIGHT BRUCE, with the concurrence of Lord Justice TURNER, after declaring how deeply indebted they felt for the assistance of the judges, thought the proper course to be taken at present was to leave the Rolls order undischarged, with liberty to the defendants to bring and proceed with such actions as they might be advised; and to grant an injunction, according to the prayer of the amended bill, restraining the directors from forfeiting, or declaring forfeited, or selling, or disposing of as forfeited, any other shares of the company, on the ground either of non-payment of the calls, or non-execution of the Deed of Settlement, and restraining the trustees from executing that deed on behalf of themselves or other subscribers of the company until further order, with liberty to apply.

THE MINER'S SONG.

[FROM THE GERMAN OF KÖRNER.*]

"Ah! little reck we oft how large a debt
We, 'midst life's comforts, to those toilers owe
Who in the quarry or the furnace sweat,
Who raise the ore, or blast the rock below!"

The Crystal Palace: a Poem by John Holland.

GOOD SPEED—GOOD SPEED—to the regions of Night!
Good speed in the fearful abyss!
Through the rocky shaft gliding, far down we alight,
In the ore-laden regions 'neath this.
With darkness and horrors deep under the earth
Has Destiny doomed us to strive from our birth.

There moveth the strong arm the hammer that wields—
Gaping chasms spring wide at the stroke;
And Death beckons dark from each entrance it yields,
In grey wreaths of breath-stifling smoke.
Yet bold goes the miner where no arm can save,
And around him oft closes the vapoury grave!

We wander deep, deep, through the fathomless way,
Where the first germs of ore-life unfold;
Through the serpentine paths of the labyrinth stray
With footstep all daring and bold;
We know not—we care not—our dark empire won—
How things go above, in the light of the sun.

And when vassals and lords are at issue and strife,
Nor will list, tyrant Force! but thy voice,
And nations with battle and slaughter are rife,
We in shelter and safety rejoice.
For they of the world where these wild passions glow
Will never disturb the deep peace down below.

It is true, many terrible conflicts have we—
In the dark shaft fierce contests we hold;
The Night from her spirits of darkness we free,
And have conquered the mighty Kobold.†
The fire-damp so fearful, 'tis ours to subdue,
As against us it rushes, dark-burning and blue.

True, oft burst upon us, where men never stray,
The waters around us that roll,
But Genius can conquer rude Strength by its sway.
And we teach them themselves to control.
Subdued, they afford us their watery might—
And we bear the rule in the regions of Night.

All silently wove through the hard rocky wall,
The veins of the bright-glancing metal are found;
And the stroke of the uplifted hammer doth fall
Sheer down with a thundering sound.
And what we have won from the horrors of night,
Rejoicing we bear to the regions of light.

It flies o'er the world's four quarters in haste—
Each would seize on it never to part;
Upon it all thoughts and all wishes are placed,
And captive it takes every heart.
Only we have been never befooled by its might—
Only we know its true worth—how transient and slight.

And therefore a lighter, a merrier mood,
Through life we maintain from our birth;
The wasting pursuit of each vain idle good
We bury below in the earth.
But still feel for Fatherland, Duty, and Love,
In the depths of the earth as in daylight above.

And when, Life's Mine exhausted, at length shall appear,
The great pay-day for work over-night,
Then the spirit shall spring from the depths even here—
From the gloom of *the shaft* to the *Light*.
And may Heaven's blessed Mine of pure joys be our meed—
And its host hail our own with "GOOD SPEED!"—with "GOOD SPEED!"‡

* The youthful poet, Körner, the only son of a clergyman, famed for his *Address to his Sword*, on the eve of the battle in which he fell, bravely fighting for his country, was originally a surveyor of the mines, and wrote the above spirited and beautiful poem while occupying that post.

† A goblin, the spirit of the earth; as further described the fire-damp.

‡ "Glück auf!" "Glück auf!"—originally the good wish with which they accompanied their perilous journeys in the dark caverns of the earth, is now the usual salutation, and the general motto of the miners in Germany.

ON SCIENCE IN THE MINES.

BY HERBERT MACKWORTH, M. INST. C.E., INSPECTOR OF COAL MINES.

[Abstract of Lecture delivered at the Educational Exhibition in St. Martin's Hall.]

The history of the progress of mining science is, in fact, the history of the progress of mining. Although there are traces of mining at a very early period in Britain for tin, lead, iron, gold, &c., it was not until the 16th century that it began to rise to its present importance. At that period coal was first employed at Newcastle for other purposes than burning lime or blacksmiths' fires, and a small quantity of copper was first sent from Cornwall to South Wales to be smelted. In 1726, 5000 tons of copper ore were raised in Cornwall; the production now amounts to 181,000. The supply of coal to London in the year 1700 was 470,000 tons; it now amounts to upwards of 4 million tons per annum, and the whole production of Great Britain to 54½ million tons. The production of iron in the year 1750, before the use of pit-coal for smelting, is stated at 30,000 tons; it now exceeds 2½ million tons annually.

The first steam-engine for pumping water from mines was applied at the Griff Colliery, near Coventry, about 1700. The Cornish pumping-engine, performing a duty of raising upwards of 100 million pounds a foot high, by the consumption of a bushel of coals, presents the highest economy which has hitherto been attained by machinery. For earlier improvements in winding, we are especially indebted to Newcomen, Smeaton, and Watt. The winding engines are sometimes of 200-horse power, and raise 2 tons at a time, at a speed of 20 miles per hour. Guides down the shaft answer the same purposes as the rails on a railway; wire ropes, which are half the weight of hempen ropes, are taking the place of the latter. The underground haulage, by the application of mechanical science, has been reduced to one-third of the cost, and yet the majority of mines proceed on the old system. The guides in shafts alone save their cost twice over the first year, and yet hardly a dozen of the metallic mines have adopted them.

The scientific principles of ventilation were laid down by M. Jars, in 1764. In 1760 a Mr. Spedding, of Newcastle, first carried the air in one current into every part of a mine, but it was left for Mr. Buddle, in 1813, to introduce the greatest improvement in modern ventilation—the splitting of the air, which is simply providing several channels for the air to pass through the workings in lieu of one. By this means a much larger quantity of air, and consequently in a purer state, flows through the mine. To Humboldt, in 1796, we are indebted for a safety lamp to enter poisonous and explosive gases; and to George Stephenson and Davy, in October, 1815, for the splendid invention of a safety lamp for mines containing carburetted hydrogen, which has now sustained a trial of 38 years, without one well-ascertained case of failure, at least in the north of England. Not more than 3 per cent. of the explosions of fire-damp occur in mines where safety lamps are exclusively used. The ventilation of English coal mines is generally produced by a furnace, which, being kept burning at the bottom of the upcast shaft, heats or rarifies the air, so that it ascends, whilst cold air necessarily descends another shaft into the mine to supply its place. In Belgium, where the science of ventilation is better understood than in England, the furnaces are all being replaced by machines which pump out the air, and are more economical. They are also in that country, he regretted to say, much in advance of us in having carried out strictly the principle of ascensional ventilation, which prevents any light gas from collecting in a mine. We have much to learn from the Continent in regard to the safety of mines, in boring, in machines for raising men, in the method of extracting the whole of the minerals, and in coking. Mining schools should impart this information.

Borings have been executed to a depth of 764 yards; shafts of 14 feet in diameter have been bored by machinery, and at Homburg a boring is now being executed to a great depth, to obtain water of a sufficient temperature for hot baths without the intervention of fuel.

A stimulus was given to improvements in mining in Belgium by the premiums awarded in 1840 by the Royal Academy of Sciences, and since that time greater progress has been made in the application of science to mining, and, consequently, the extension of mining, in Belgium than in any other country in a similar period.

In every part of a miner's education and a miner's practice the application of science can and ought to hold the chief place; for though we possess many men of genius and industry, who, after having laboriously groped their way for years, have given to their undertakings the evidencies of a master's hand, yet in the interval how much has been lost to the country in costly experiments and in the relinquishment of deep mines. And if we could analyse the long mental process, it would be seen how largely these men had imbibed from time to time the important truths developed by educated minds of deep thought. It must not be forgotten that this experience has often been attained at a great expenditure of life, time, and money. Enormous are the sums which have been squandered since the publication of William Smith's geological map in 1816, in fruitless searches for coal in the Oxford clay, in the millstone grit of the south and centre of England, in the black slates of the Silurian, and in the lower lias and oolite. In other places losses have occurred from mistaking blende for spar or lead-ores; calamine thrown into the smelting furnace, under the impression that it was iron ore, speedily undeceived the iron-master; thousands of pounds worth of the sulphide and black oxide of copper have been thrown away as worthless. On the other hand, by Professor Plattner's discoveries, gold ores in Silesia, which contain one grain of gold in 228,000, have been made to pay for working, and in Siberia similar ores, containing only one grain in half a million grains of sand. As an example of the successful application of science and perseverance, the discovery of gold in Australia by Mr. Hargreaves, the honoured pioneer of the Australian El Dorado, might be cited; and through that gentleman's kindness he was able to exhibit some choice specimens, characteristic of the different localities.

In giving a hasty sketch of the efforts which have been made to introduce mining education, the first place must be conceded to the Academy of Frieberg. It was founded in 1765, and reached its celebrity in 1775, under the famous Werner. Pupils are to be found there from distant countries—Spain, Russia, and the Brazils. Some of the most improving proprietors of mines and smelters in this country have taken advantage of the education it affords. Besides the general classes, there is one for managers or captains, of whom the number is restricted to forty. The course consists of arithmetic, geometry, art of mining, elementary mineralogy, grammar, and drawing.

For an account of the celebrated schools of Schemnitz, Tarnowitz, and St. Etienne, a pamphlet by Prof. Warington Smyth should be referred to. The mining schools at Liege and Paris, established in 1810, at which the Government engineers pass a three years' course and four strict examinations, are schools of the highest character. At Alais, in the department du Gard, a school for master miners, under the direction of M. Etienne Dupont, affords many useful suggestions for the class of mining schools which are chiefly required in this country.

The School of Mines, under the able presidency of Sir H. De la Beche, although distant from the centres of mining operations, has the advantages arising from the Geological Survey, from the fine museum which illustrates it, and from the records and laboratories. Field instruction is given in geology, mineralogy, and palæontology. Useful as this institution at present is, as a centre for mining information, it may yet hold a still more distinguished position as the active supporter of the mining schools which are now being formed in the principal districts. Other institutions, which have afforded scientific information applicable to mining, are deserving of mention, as Durham University, the course at which began in 1838, Dublin University, and King's College, London, where in 1831 the united efforts of three eminent professors were able to supply a want, long felt, for education in the applications of science.

In the month of May in the present year, a meeting of the coal trade of Great Britain was held in London, at the request of a committee of the House of Commons, at which resolutions were passed, recommending that a central mining school, with branches therefrom, should be established in some suitable colliery district. This was followed by a strong recommendation to her Majesty's Government, embodied in the report of the committee of the House of Commons.

There are at the present time four mining schools, which are about to be commenced by the exertions of the proprietors and managers of mines. The seed sown in Cornwall by Sir Charles Lemon, in 1838, is bearing fruit: 1500*l.* is already subscribed, and a county meeting is called for the 12th of September, to inaugurate a central school at Truro. The Newcastle school, which is being formed under the auspices of Mr. Nicholas Wood,

and the North of England Institute of Mining Engineers, will, it is expected, be in operation before the end of the year. The enterprise of the coalmasters of the Bristol district is founding a Central School of Mines for Colliers, as well as providing lecturers and instruction to district schoolmasters; and at Swansea a committee has been for some time appointed to carry out a School for Mining, Metallurgy, and Navigation. Only that morning he had received a letter from a colliery proprietor, Mr. Nevill, offering to subscribe 30*l.* annually for this purpose.

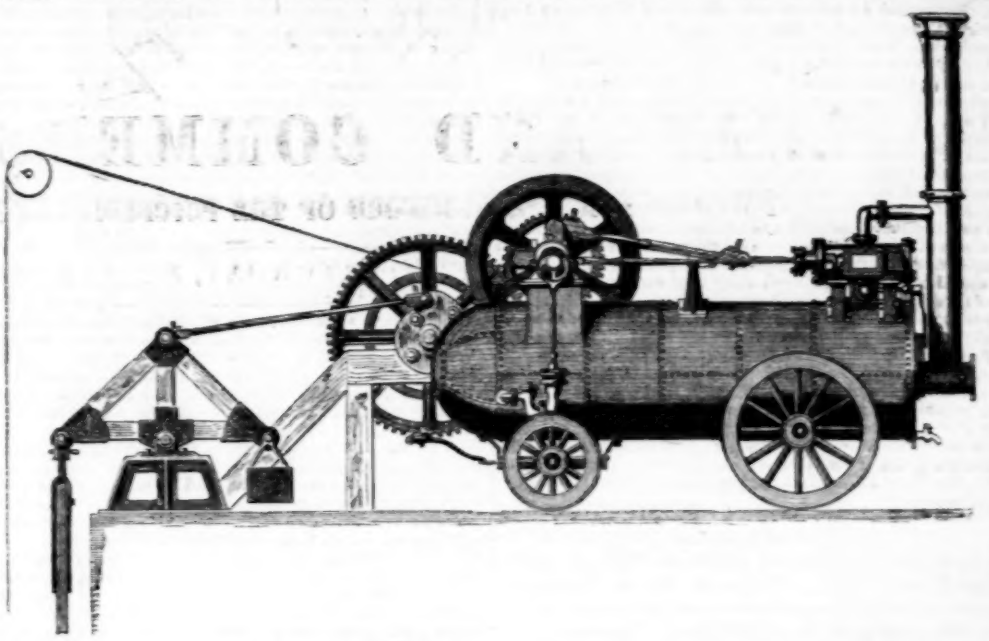
THE MANUFACTURE OF ALKALI.

Mr. A. G. Gray, jun., delivered an interesting lecture, on "Alkali," at the Newcastle College of Medical and Practical Science. In opening, Mr. Gray, having vindicated Northumberland from some rather rude remarks of Mrs. Stowe, directed his observations to the manufacture of alkali—the "soda" of commerce—a chemical combination of carbonic acid and soda. The metal *sodium*, which, combined with oxygen, constitutes soda, was discovered by Sir Humphry Davy, in 1807. The nitre of Scripture is supposed to have been impure carbonate of soda; but this surmise is not universally received. The nitre of the moderns is a different substance altogether, being nitrate of potass, or saltpetre. Mr. Gray glanced over a few of the proofs that carbonate of soda and the nitre of the ancients are identical, and came down to the time when its usefulness began to be felt over the whole civilised world. We join company with him at the period of the French Revolution, which, it appears, among its other effects, is responsible for having "put a stop to all means of obtaining soda." Soda is most largely used in the manufacture of glass and of soap; and in both processes potass may be substituted at a pinch. The French Republic found, however, that every particle of potass was now required in another manufacture—that of gunpowder—and soap and glass were likely to go unmade. The Committee of Public Safety invited the counsels of all good citizens; and the Emperor Napoleon appealed, not to their patriotism only, but also to their pockets; for he offered a large reward for the simplest and cheapest method of making soda. Several suggestions were sent in: Leblanc's was adopted. His plan was to convert common salt into sulphate of soda, and then to convert the sulphate into carbonate; and such, essentially, is the process pursued to this day. Leblanc, however, never received the reward of his ingenuity. The Bourbons were restored, and the discoverer was neglected. By Leblanc's process, the manufacture of sulphuric acid has become the foundation of the manufacture of soda. Sulphuric acid is obtained by oxidising sulphur to its utmost extent. When sulphur is burnt in air, the product is sulphurous acid; when burnt in oxygen, sulphuric acid. Sulphuric acid is obtained by our manufacturers by burning sulphur in common air along with some substance which gives off oxygen. The sulphurous acid and the oxygen are conveyed into leaden chambers, and condensed by means of steam. The sulphuric acid forms like dew upon the sides of the chambers, trickles down, and is drawn off at the bottom for use. The substance burnt with the sulphur was at first nitrate of potass or saltpetre; but nitrate of soda has since been substituted. To such a state of perfection has the manufacture of sulphuric acid been brought, that whereas in theory 100 lbs. of sulphur ought to produce 306 lbs. of sulphuric acid, the manufacturer does actually obtain 300 lbs. From the leaden chambers the acid is conducted by leaden pipes to concentrating pans, which also, for ordinary purposes, consist of lead; but when it is required that the acid shall be very highly concentrated, vats and stills made of platinum are used. Ordinarily it is boiled down in leaden pans, and run into a decomposing pan containing common salt. This substance consists of chlorine and sodium. The oxygen of the water converts the sodium into soda. The sulphuric acid, uniting with the soda, forms sulphate of soda—the hydrogen and chlorine passing off as muriatic acid gas, the foe of our fields.

To banish this unpopular product to the upper air, long chimneys were erected, that of the Friar's Goose Works being 69 ft. higher than the topmost pinnacle of St. Nicholas's Church, Newcastle. The muriatic acid gas, however (says Mr. Gray), is now got rid of through its affinity for water, a discovery made within a month of the erection of the tallest of the tall chimneys—that of the St. Rollox Works, in Glasgow. The gas is allowed to ascend a tower filled with coke, and through which water is continually passing; a combination takes place, and muriatic acid runs out at the bottom. For the manufacture of soda, salt is imported into the Tyne to the extent of about 80,000 tons a year; 100 lbs. of this salt, with 80 lbs. of sulphuric acid, makes sulphate of soda; the muriatic acid produced doubles the quantity of sulphuric acid used. It was formerly a waste product, but is now applied in the manufacture of bleaching powder and bicarbonate of soda; also for making glue from bones. The sulphate of soda now produced is mixed with an equal quantity of dry ground chalk and half its weight of small coal. This mixture is well worked in a reverberating furnace, and drawn out in a liquid state. During this time the sulphur has left the lime, and the carbonic acid resulting from the combustion of the coals and chalk has gone to the soda. We have, therefore, in the ball soda, sulphuret of sodium and carbonate of soda. When the ball cools it is broken down, put into a vat, and warm water is poured upon it. In about six hours the liquor is run off, and fresh water run upon it, from time to time, till all soluble matter is abstracted. By this means the carbonate of soda is washed out, and the oxysulphuret of calcium, being insoluble, left behind. This residue is the tank waste, or tank heap, or soda maker's waste, forming one of the picturesque features in the landscape so admiringly pourtrayed by Mrs. Stowe. The liquor run off from the lixiviation of the balls is boiled down to dryness with sawdust, and the resulting salt is a mixture of carbonate of soda with caustic soda and sulphuret of calcium. This salt, usually called black or caustic salt, is burnt at a dull red heat. The sulphur is thus dispelled, and the soda carbonated by the combustion of the charcoal or sawdust. The carbonate of soda, now drawn out, usually contains between 50 and 52 per cent. of alkali. If pure enough, carbonate of soda may be sold in this state; but if, as commonly happens, it has gained some impurities, either from the sawdust, or through the formation of cyanide of iron in the tanks, it requires to be purified. This is done by dissolving the carbonate in boiling water, and allowing the impurities to sink to the bottom. The pure liquor is decanted off; part is run to the pans, in which it is boiled down to dryness afresh; it is then thoroughly dryed in a furnace, and ground in a powerful mill; and this forms the common alkali or carbonate of soda of commerce, and may be obtained at any strength, from 30 to 58 per cent. of alkali. The same liquor, mentioned before, is also run warm into vats, and placed in large, cool, well-ventilated house, where, in about 8 or 12 days, according to the weather, it crystallises, forming the common soda or washing crystals. The liquor which does not crystallise—the "mother liquor"—is run back, to be made into weak alkali. To convert the soda into bicarbonate of soda, the crystals are placed in a large air-tight cistern, into which carbonic acid is introduced. The crystals lose water of crystallisation, and absorb another equivalent of carbonic acid. It must be carefully dried at a low temperature, or it changes into sesquicarbonate of soda. Mr. Gray concluded his lecture by passing from the mode of manufacture to the extent of consumption. In 1838, 50,000 tons of soda ash and 20,000 tons of crystallised carbonate of soda were made in England. In 1846 the manufacture was doubled; and at the present time our annual exports amount to 1,070,265 cwts., there having been an increase of 90,000 cwts. in the past as compared with the preceding year. Of the home consumption it is impossible to obtain an accurate account. On the Tyne there are 15 manufactories, which each make, on an average, 100 tons of crystals per week, or 1500 tons per week together, or 75,000 tons per year. These works will also produce, besides, about an average of 90 tons per week of alkali, or in all, 66,500 tons per annum. Together, 141,500 tons: a rough estimate of the produce of the Tyne.

In conclusion, this important branch of our national manufactures enriches Sicily, whence we draw our sulphur; and Peru, the source of our supply of nitrate of soda. To meet the wants of Britain, Russia can extract the costly metal, platinum, from her mines at a remunerating price—the platinum vats of our manufactories costing from 1000*l.* to 2000*l.* each. The use of nitrate of soda, in place of saltpetre, has enabled us to return to our fields that potass which is so necessary to their fertility; and, moreover, has lowered the price of gunpowder, glass, and soap. In almost every department of industry, the production of soda from common salt has made itself beneficially felt, and, in particular, encouraged and perfected the manufacture of soap and glass. Liebig takes the consumption of the former of these articles—soap—as a fair measure of a country's civilization and wealth; and if soap, so also soda. England, then, must be in the foreground of civilisation; and the Tyne, Mr. Gray infers, must be the most civilised of rivers; "for there is more soda made on its banks than on those of any river in the world."

MEDWIN AND HALL'S PATENT PORTABLE STEAM-ENGINE ON WHEELS.



The woodcut represents a new arrangement of boiler and engine, successfully introduced for several years by MEDWIN and HALL. Its construction affords a wide field for the application of portable steam-engines, embracing capabilities rendering employment of steam more general than hitherto contemplated or offered by any previous competitor.

The portable engines commonly used are worked by locomotive boilers—liable to get out of order, and used almost exclusively for agricultural purposes—to which MEDWIN and HALL's engines are also applicable, though not regarded as the primary part of their object, but to be employed in work of greater magnitude, required by contractors, colliery owners, miners, and especially for the Colonies, in sawing, pumping, grinding, crushing, hauling, winding, stamping, and every purpose to which steam power is available. Manufactured with or without wheels, from 4-horse power to 50-horse power. The whole of the motional parts are fixed on the boiler, including a pump to feed the same, a fly-wheel, which may be used as a band-wheel, or the power applied in any other way.

The boiler is different from any other, being what is termed "the Horse-Shoe"—very economical in fuel—the furnace arranged to burn wood or coal at pleasure: they have an efficient safety-valve, and MEDWIN and HALL's patent steam and water gauges, thereby preventing the possibility of accident from shortness of water, or overpressure of steam. May be worked by the most inexperienced person.

92, Blackfriars-road, London.

The following observations appeared in the *Morning Advertiser*, *Morning Post*, *Daily News*, *Standard*, and *Sun* newspapers, and in the *Mining Journal*:—

PATENT PORTABLE STEAM-ENGINE.

We witnessed on Thursday a trial of a new Portable Steam-Engine, constructed by Messrs. MEDWIN and HALL, of the Blackfriars-road, which is undoubtedly a vast improvement, and must, if we mistake not, cause a complete revolution in mining operations. Any mine now requiring steam-power can obtain that important auxiliary in a few weeks. Our columns continually testify to the delays in surface operations, arising either from the difficulty in obtaining masons, or even, when the engine-house is completed, the time that is lost in the erection of efficient machinery. It is well known that the portable engines generally used are worked by locomotive boilers, which are liable to get out of order, and thus cause vexatious delay and expense. In Messrs. MEDWIN and HALL's this complaint is not likely to occur. The whole of the motional parts are fixed on the boiler, including a pump to feed it, and a fly-wheel, which may be used as a band-wheel, or the power applied in any other way. The boiler is different from any other, being what is termed the "horse-shoe." The present engine has been constructed for the Old Trewether Consolidated Mining Company, and was started in the presence of several members of the committee; it is called a 20-horse power, although capable of being driven to 25. The speed was 60 strokes per minute, and performed the work in such an admirable manner, that not the slightest vibration is perceptible. It consumes about 6 lbs. of coal per hour per horse power, and the total weight is only 8 tons. The Old Trewether Company intend sending it to the mine by railroad, and confidently expect to have the water in fork three weeks after its arrival. At the time of the shaft filling with water there were 35 tons of antimony, which, as the company intend to smelt themselves, they estimate of the value of £35 per ton. The portable engine will enable them to realise the amount in a less number of weeks than under the old system they would in months. The company will also have the advantage of removing the power to any part of the mine, at a trifling expense. We understand the Great Duchy Silver-lead Mine hired one of these engines for three months, and, from the admirable way it has worked, have since purchased it. Messrs. Medwin and Hall have also supplied them to the Dowlais Iron Company and the Aberyschan Iron-works, for the purpose of winding and pumping. Mr. Medwin took out a patent on the 23d of August for still further improvements in generating steam in engines on the top of boilers. Mr. Medwin's improved water and steam gauge was attached to the engine we have noticed, and acted admirably.—*Mining Journal.*

The following is a list of engines sold during the present year:—

Hudson's Bay Company.	H. Bent, Esq., London.
Southampton Dock Company.	Messrs. Grissell's, R. C. Ironworks, Lond.
Aberschan Iron Company, Wales.	J. Nelson, Esq., Warwick.
Dowlais Ironworks, Wales.	J. Blackwell, Esq., Dudley.
Penllyne Court Mine, Wales.	Old Trewether Mine, Cornwall.
Penmaen Mine, Wales.	Great Duchy Silver-Lead, Cornwall.
North Towy Mine, Wales.	J. Croft, Esq., Brighton.
Poltimore Mining Company, Wales.	Messrs. C. J. Mare and Co., Millwall.
Sir A. Webster, Bart., Dolgelly, Wales.	Imperial Austrian Government.
Jno. Knowles, Esq., Worcester.	Austrian Lloyds, Trieste.
Bristol Water-works.	East Indian Railway Co., Moorgate-st.
Hon. Board of Ordnance.	J. Paul, Esq., Worthing.
Messrs. Fox, Henderson, & Co., London.	Bristol Water-works Company.
J. Kelk, Esq., London.	

Inverness Bridge, Rochester Bridge, and the Chelsea New Bridge.

FOREIGN MINES.

Quartz Rock Mariposa.	Alliance Gold Mining Company.
Carsons Creek Mining Company.	Ave Maria Gold Mining Company.
Anglo-Australian Gold Mining Company.	Anglo-Californian Gold Mining Company.
Dalecarlia (of Sweden) Silver-lead Mining Company.	Mount Alexander Gold Amalgamating Co.
	British Australian Gold Mining Company.

The following is a list of contractors, and others, who have rented these engines during the present year:—

Thos. Jackson Esq., Pimlico.	Thos. Earl and Co., Westminster.
J. Kelk, Esq., Pimlico.	Messrs. Baker and Sons, Lambeth.
G. Myers, Esq., Lambeth.	Messrs. Rigby, City.
— Spicer, Esq., Richmond.	Messrs. Piper and Sons, City.
— Carless, Esq., Richmond.	Messrs. Knight and Son, Bow.
J. Perry, Esq., Hackney.	Messrs. Bates and Co., Lock's-fields.
— Cooper, Esq., Leicester.	Crystal Palace Company, Forest Hill.
H. Johnson, Esq., Dudley.	R. Goodison, Esq., Lewisham.
W. Dethick, Esq., London.	J. Clark, Esq., Furnival's Inn.
— Smith, Esq., Woolwich.	B. Fowler, Esq., Whitefriars.
W. Piper, Esq., Lambeth.	— Richards, Esq., Blackfriars.
Messrs. Newall and Co., Newcastle.	— Spiller, Esq., Blackfriars.
Messrs. Hutchins and Co., Millwall.	Messrs. Kuper and Co., East Greenwich.

And many others.

The following are certificates, received from the owners of these engines, now at work at mines, &c.:—

Old Trewether Consolidated Mining Company, Cushion-court, Old Broad-street. Sept. 8, 1853.

GENTLEMEN,—In accordance with your request, I have this day examined Messrs. MEDWIN and HALL's Portable Patent Steam-Engines. I beg to say that I was highly pleased in the way and manner the 20-horse power engine, for the Old Trewether Lead, Silver, and Antimony Mines, worked this day 70 strokes per minute. The engine is calculated to do much more if required. The boiler, weighing about 4 tons, of the very best quality iron, and well put together; other parts will bear the strictest examination—the engine, in all, weighing about 8 tons. The whole is set on four wheels, like any other carriage, taken off or put on in a few minutes, and can be moved from one place to the other at the shortest notice. I think, as a miner of long experience, that these engines will answer every purpose for new mines and quarries, and in places where there is not a large quantity of water, and a 50 or 60 cylinder steam-engine is not required. In a short time we shall see long and expensive adits done away with, and MEDWIN and HALL's engines set up to sink our mines to a depth of 30, 40, or 50 fms. There is no doubt on my mind but these engines are the best and cheapest ever invented for a quick trial; and those, like Mr. Cochran's crushing machines, will be in general use throughout England and elsewhere. Great credit is due to the inventors of those valuable machines. W. VERRAN.

Great Duchy Mine, Lantegica near Camelford, Sept. 17, 1853.

GENTLEMEN,—In answer to your enquiry as to the working of the portable high-pressure steam-engine hired by the Great Duchy Mining Company, and afterwards purchased by them, I beg to state, from nearly nine months' experience, that it works very well; much better, indeed, than we at first expected. I have known many mines, when first started, that have presented most favourable indications, but have been abandoned just on the eve of good discoveries, from the inability of the adventurers to work them, for want of top water for wheels, or a sufficient capital to erect a Cornish steam-engine, and other parties coming after them have derived all the benefit. I allude, of course, only to those mines where the water is not very plentiful, and a large engine is not, therefore, required. In such cases your portable engines will be found of great service, and I can strongly recommend the adoption of them to mining parties. Wishing you every success,

I am, Gentlemen, your obedient servant, W. PENROSE.

Tregurdock Mine, Feb. 2, 1854.

GENTLEMEN,—Agreeably with your request some time since, I beg to say, yesterday I inspected the portable steam-engine you sent from your firm to the Old Trewether Mine, near Port Isaac. I find it is an engine of 20-horse power, with two cylinders attached to the boiler, with an efficient safety-valve, and patent steam and water gauges; thereby preventing the possibility of accident, from shortness of water, or overpressure of steam. I find the company of the mine has put the engine in gear on the winch principle, which will answer well. The engine works in the hour 4½ strokes to one in the shaft, which causes the engine to work more steadily, and answer better in the shaft. I found it capable of going full 50 strokes a minute doors, and 12 in the shaft, without the least difficulty, and with a very moderate consumption of coals. This engine, I consider, will thoroughly prove the mine, and put it to a very considerable depth below what it is at present, and should the present Trewether Company prove as lucky as former companies, a fortune is sure to ensue. I must say great credit is due to the projectors of this engine, which will answer, as is well adapted for many of our Cornish mines. With these engines we can pump wind, crush, or stamp, &c. One remark I wish to make is, great credit is due to Mr. George Terril, the fitter up. Wishing you every success in the sale of these engines,

I am, Gentlemen, yours truly, W. PENROSE.

To Messrs. Medwin and Hall.

Old Trewether Consols, near Wadebridge, Cornwall, April 3, 1854.

GENTLEMEN,—I have much pleasure in bearing testimony to the efficiency of your 20-horse patent portable steam-engine, which is now at work in the above mine. The engine, since her erection, has been working exceedingly well. She is now, with 6 in. box, drawing water with the greatest facility, 30 fms. deep. This duty appears scarcely anything for the engine to do. The coals she at present consumes is, on an average, from 6 to 7 cwts. in 24 hours. I could strongly recommend your patent portable engines for the working of shallow mines, particularly where despatch and economy is studied. I am, Gentlemen, your most obedient servant,

Messrs. Medwin and Hall. RICHARD VERRAN.

North Towy Mine, Carmarthen, April 8, 1854.

GENTLEMEN,—In reply to your favour of the 31st March, I am much pleased with the portable engine supplied to this mine by your company. It performs its duty exceedingly well, and I consider them well adapted for the development of lodes at a shallow depth. We are now working with a 6-in. lift, and with our present amount of water, I consider that the engine will drain the lode to the 40 fm. level.

I am, yours respectfully, W. H. REYNOLDS.

Messrs. Medwin and Hall, London.

London: Printed by RICHARD MIDDLETON, and published by HENRY ENGLISH (the proprietors), at their offices, No. 26, FLEET-STREET, where all communications are requested to be addressed. [*September 9, 1854.*